Use and Misuse of Forest-harvested Fruits in the Iquitos Area

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Abstract: *Of 193 fruit species observed to be regularly consumed in the region surrounding Iquitos, Peru, 120 species are exclusively wild-harvested and 19 more originate from both wild and cultivated sources. The wild-harvested fruits of 57 species belonging to 24 different plant families are sold in the Iquitos market and are very important in the economy and diets of the area. Nearly half of the Iquitos fruit vendors sell wild-harvested fruits (if fruits used as vegetables or starch sources are excluded), and over half of the fruit species sold are wild-harvested. Many fruit species consumed at Iquitos differ from those consumed in other parts of Amazonia. Although some native fruit species are beginning to be grown as crops, the wild populations of these high-potential species are being rapidly depleted by destructive harvesting techniques as market pressure begins to build. In the last few years, the availability of several of the most popular fruit species has decreased markedly. If nondestructive sustained-yield harvesting of resources such as wild-harvested fruits is to play its suggested important role in tropical forest conservation, much stronger efforts will be needed to prevent destructive overharvesting of these potentially significant resources.*

Resumen: *De las 193 especies de frutas que se ha observado se consumen regularmente en el área que rodea Iquitos, Perú, 120 especies son cosechadas exclusivamente en estado silvestres y otras 19 se originan tanto de fuentes cultivadas como de fuentes silvestres. Las frutas cosechadas del ambiente silvestre de 57 especies correspondientes a 24 familias diferentes de plantas, son vendidas en los mercados de Iquitos y son muy importantes en la economía y la dieta del área. Excluyendo las frutas vendidas como vegetales y fuentes de almidón, cerca de la mitad de los vendedores de fruta de Iquitos venden fruta silvestre y más de la mitad de las especies de frutas vendidas son silvestres.*

Muchas de las especies de frutas consumidas en Iquitos difieren de aquellas consumidas en otras áreas de la Amazonía. Aunque algunas de las especies nativas del área están empezando a ser cultivadas, la población silvestre de estas especies de alto potencial está siendo rápidamente exterminada por técnicas destructivas de cosecha, al incrementarse la presión del mercado.

En los últimos años, la disponibilidad de varias de las especies de fruta más populares ha decrecido marcadamente. Si se desea que la cosecha sostenible y no destructiva de estos recursos juegue el importante rol sugerido para la conservación del bosque tropical, será necesario incrementar los esfuerzos para prevenir una sobre-cosecha destructiva de estos recursos potencialmente significativos.

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Introduction

The world's tropical rain forests are being cut down at an alarming rate, often in a one-time exploitation that results in a few years of crops followed by abandonment to permanent scrub or conversion to low-quality pasture. One strategy to slow the wholesale destruction of tropical rain forest is to find ways to utilize these forests as renewable resources. As summarized in a recent Office of Technology Assessment report (1984), "The value of [intact] tropical forests could be increased by developing new products or by encouraging the collection and processing of existing products." Harvesting a variety of natural products from the extant forest, possibly including medicinal plants, fruits, selected timber species, rubber, and wild game, has been suggested as a way to generate such a strong forest-based economy that effective pressure against further forest destruction could result (Myers 1984; OTA 1984). The frequent use by local campesinos of many species of wild fruits supports the possibility that such fruits might be developed as economically significant crops harvested from the intact forest. Indeed, Myers (1984, p. 193) suggests that tropical forest fruits as new foods probably offer the greatest economic promise of any tropical forest product. From a nutritional standpoint, fruits are especially valuable since they are highly "nutrient dense," with high levels of desirable vitamins, minerals, and fiber, but low levels of calories, fats, and other undesirable nutrients (Sims & Peterkin 1987).

During many years of field work in the Iquitos region, we have made numerous incidental observations of use of wild fruits. Part of our purpose here is to document the fruit species that we know to be widely used by campesinos in the Iquitos area and to focus attention on several that seem to have the most economic potential, either as plantation crops or as wild-harvested exports. A second objective is to point out a serious and previously overlooked problem that must be overcome if markets for new fruit species are to be developed.

Materials and Methods

During extensive field work in Amazonian Peru over the past decade, we have recorded the uses of wild fruits by the local populace. In addition, the senior author has visited the Iquitos market (see Padoch 1987) nearly every week for the past nine years in an attempt to identify the wild-harvested fruits on sale and, sporadically, to note their prices. During 1987, the wild-harvested fruits on sale in the Iquitos market, and their current prices, were tabulated monthly.

Tabulation of fruit prices is complicated by Peru's rampant inflation, as well as by the recent conversion from the sol to the inti (= 1000 soles) as the official Peruvian currency. Prices reported here are for 1987 except as otherwise noted.

Identifications of the plant species are vouchered by collections of the Flora of Peru project deposited in the herbarium of the Missouri Botanical Garden, with duplicates in the herbaria of the Universidad Nacional de Amazonía Peruana and Universidad Nacional Mayor de San Marcos. In many groups, these identifications were provided by taxonomic specialists; in others, they were based on matching with identified specimens in the Missouri Botanical Garden herbarium. In some groups, notably the Sapotaceae, identifications are still very incomplete.

Results and Discussion

Use of Wild-harvested Fruits

We have observed the use of about 139 wild fruit species by campesinos in the Iquitos area (Table 1). This figure includes 19 species eaten from both wild and cultivated sources and an estimated 16 Sapotaceae species eaten more or less regularly that are difficult to tabulate because of taxonomic problems. Many additional species are probably eaten on occasion, but Table 1 only includes those species we have personally observed to be eaten. Indicated parenthetically but excluded from our calculations are a number of fruits that grow wild in the forests of Loreto and are consumed elsewhere but are not known by us to be widely consumed in Amazonian Peru. Also excluded are fruits that are reported to be consumed by various tribal groups in Amazonian Peru (cf. Prance 1972; Prance et al. 1987; Vickers & Plowman 1984) but that do not seem to have reached the general population.

The taxonomic diversity of the fruits eaten at Iquitos is impressive. Fruits of 39 families are eaten, and 34 of these families include species with wild-harvested fruits. The preeminent fruit-producing family is the Palmae, with 23 species producing wild-harvested fruits eaten at Iquitos; 14 of these species are sold in the Iquitos market. Other important fruit-producing families at Iquitos are the Apocynaceae (8 wild-harvested species, 1 of them also cultivated), Annonaceae (7 wild-harvested and 4 cultivated species), Cucurbitaceae (2 wild-harvested and 8 cultivated species), Leguminosae (12 wild-harvested, 1 of which is also cultivated, and 7 cultivated species), Moraceae (10 wild-harvested species, 1 also cultivated, plus 2 cultivated exotics), Myrtaceae (4 wild-harvested species, 1 also cultivated, plus 4 exclusively cultivated species), and Sapotaceae (about 16 wild-harvested species, 1 also cultivated, and 1 exclusively cultivated species). That so many kinds of tropical forest fruits are consumed around Iquitos is noteworthy but not surprising, considering that more than 100 species of fruits, the majority presumably wild-harvested,

Table 1. Fruits consumed in the Iquitos area.

Species[a]	*Vern. name (English name)*[b]	*Status*[c]	*Use*	*Sold in Iquitos*[d]	*Harvesting method*
Anacardiaceae					
Spondias mombin (V7031) (*Spondias purpurea* not used locally)	*Ubos*	W/C	Refrescos, ice cream	XX	From ground
Spondias cf. *mombin* (V10481)	*Ushún*	W	Refrescos, ice cream	X	From ground
Spondias dulcis	*Taperiba*	C	Refrescos, ice cream	X	From ground
Anacardium occidentale	*Marañón* (cashew)	C	Eat "apple"	X	From low branches
Anacardium giganteum (V11552)	*Sacha cashu*	W	Eat "apple"	No	From ground
Tapirira guianensis	*Huiracaspi*	W	Fleshy pulp	No	From ground
Mangifera indica	*Mango*	C	Eat pulp	XX	By hand or pole
Annonaceae					
Annona excellens	*Anona*	W	Fleshy pulp	No	From low branches
Annona montana	*Anonilla*	W	Fleshy pulp	No	Picked from low branches
Annona hypoglauca	*Guanábana sacha*	W	Fleshy pulp	No	From low branches
Annona muricata	*Guanábana*	C	Fleshy pulp, ice cream	X	From branches
Annona squamosa	*Anona*	C	Refrescos	X	Pole from branches
Annona reticulata	*Sacha anona*	C	Refrescos	X	Pole
Diclinanona tessmannii	*Tortuga blanca*	W	Fleshy pulp	No	From ground
Duguetia macrophylla	*Tortuga caspi*	W	Fleshy pulp	No	Small tree
Duguetia sp. (V10354)	*Tortuga caspi*	W	Delicious fleshy pulp	No	From ground
Rollina mucosa	*Anona*	C	Fleshy pulp	X	Pole
Rollina sp. (V1223)	*Anona*	W	Fleshy pulp	No	From ground
Apocynaceae					
Ambelania occidentalis	*Cuchara caspi*	W	Pulp (too acid)	No	From branches
Couma macrocarpa	*Leche caspi*	W/C	Fleshy pulp	X	Half from ground, half cultivated
Lacmellea peruviana	*Chicle huayo*	W	Fleshy pulp	X	Small tree bent over
Lacmellea lactescens	*Chicle huayo*	W	Fleshy pulp	No	From ground
Macoubea sprucei	*Yahuarhuayo blanco*	W	Pulp (acid)	No	Tree cut
Parahancornia peruviana	*Naranjo podrido*	W	Delicious pulp	X[e]	Tree cut
Parahancornia sp. nov.	*Naranjo podrido*	W	Delicious pulp	No	Tree cut
Rhigospira quadrangularis	*Yahuarhuayo colorado*	W	Pulp (sweet)	X	Tree cut
(Araceae) (*Monstera*: not eaten locally)					
Bixaceae					
Bixa orellana	*Achiote*	C/W	Color and condiment	XX	From branches
Bombacaceae					
Pachira aquatica	*Sacha pandisho*	W	Seeds eaten raw or cooked	No	From low tree
Quararibea cordata	*Sapote*	W/C	Pulp	XX	Ground
Quararibea ochrocalyx	*Machin sapote*	W	Pulp	No	Ground
Bromeliaceae					
Ananas comosa (*Aechmea magdalenae* not eaten at Iquitos)	*Piña* (pineapple)	C	Pulp	XX	Low plant
Burseraceae					
Protium grandifolium	*Copal, brea caspi*	W	White aril	No	From ground
Protium subserratum	*Copal*	W	White aril	No	From ground
Caricaceae					
Carica papaya	*Papaya*	W/C	Sweet pulp, also cooked green	XX	Cauliflorous tree
(*Jacaratia* not eaten at Iquitos)					
Caryocaraceae					
Caryocar amygdaliforme	*Almendro*	W	Seed eaten raw, much esteemed	X	From ground or climb tree
Caryocar glabrum	*Almendro blanco*	W	Seed eaten raw, much esteemed	X	From ground or climb tree
Chrysobalanaceae					
Couepia chrysocalyx	*Parinari, supai ocote*	W	Pulp eaten	X	From ground
Couepia dolichopoda (G27591)	*Hamaca huayo*	W	Seed eaten raw or cooked	No	Hooked pole
Couepia subcordata	*Parinari*	W/C	Pulp eaten	X	From ground
Licania sp. (V6374)	*Parinari*	W	Pulp eaten	No	From ground
Cucurbitaceae					
Citrullus lanata	*Sandia* (watermelon)	C	Pulp eaten	XX	Low vine
Cucumis anguria	*Pepino* (cucumber)	C	In salads	XX	Low vine
Cucumis melo	*Melón*	C	Sweet pulp	XX	Low vine

Table 1. Continued.

Species[a]	Vern. name (English name)[b]	Status[c]	Use	Sold in Iquitos[d]	Harvesting method
Cucurbita maxima	*Zapallo* (squash)	C	Pulp	XX	Low vine
Cucurbita moschata	*Zapallo* (squash)	C	Pulp	XX	Low vine
Cyclanthera pedata	*Caihua*	C	In salads or stuffed with meat	X	Low vine
Cyclanthera?	*Mashishe*	C	In salads	X	Low vine
Fevillea cordifolia	*Abiria, habilla*	W	Seeds for oil	No	From ground
Melothria pendula	*Pepino*	W	In salads	X	Low vine
Sicana odorifera	*Secana*	C	Pulp cooked	X	Low vine
Ebenaceae					
Diospyros (Vasquez 8664)	*Camitillo*	W	Pulp eaten	No	Small tree
Elaeocarpaceae					
Muntingia calabura	*Yumanaza, cerezo caspi*	W/C	Fleshy pulp	No	Low branches
Euphorbiaceae					
Caryodendron grandifolium	*Inchi, metahuayo*	W	Seeds cooked or mashed and oil used as soup while aqueous part drunk	X	From ground
Hevea brasiliensis	*Shiringa*	W/C	Cooked seeds	No	From ground
Plukenetia volubilis	*Maňi de monte, sacha inchi*	W	Cooked seeds (peanutlike)	No	Vine pulled down
Flacourtiaceae					
Carpotroche longifolia	*Champa huayo*	W	Tiny vestigial arils eaten	No	From cauliflorous tree
Gnetaceae					
Gnetum leyboldii	*Hambre huayo, bala huayo, pajil ruro*	W	Seeds cooked	No	From ground or vine pulled down
Gnetum nodiflorum	*Hambre huayo, bala huayo, pajil ruro*	W	Seeds cooked	No	From ground or vine pulled down
(Gramineae: although grains are technically fruits they are excluded from this survey)					
Guttiferae					
Rheedia benthamiana (V7932)	*Charichuelo*	W/C	Sweet pulp	XX (Oct–Jan)	Tree cut
Rheedia gardneriana (V8304)	*Charichuelo*	W	Sweet pulp	XX	Branches of small tree
Rheedia brasiliensis (V429)	*Charichuelo*	W	Sweet pulp	XX (Jan–Mar)	Small tree climbed
Humiriaceae					
(*Humiria balsamifera* not used locally)					
Icacinaceae					
Pouraqueiba sericea	*Umarí*	C	Thin buttery pulp	XX	From ground
Pouraqueiba paraensis	*Umarí*	W/C	Thin buttery pulp	XX	From ground
Lauraceae					
Anaueria brasiliensis	*Añushi moena*	W	Cooked seed	No	From ground
Persea americana	*Palta* (avocado)	C	Oily pulp	X	Pole or from ground
Lecythidaceae					
Bertholettia excelsa	*Castaña* (Brazil nut)	C	Seeds	X	From ground
Grias neuberthii	*Sacha mango*	W/C	Starchy pulp, fresh or cooked	XX	By hand from trunk
Gustavia longifolia	*Chope*	C	Starchy pulp	X	From branches
Lecythis pisonis	*Castaña de monte*	W	Seeds	No	From ground
Leguminosae					
Arachis hypogaea	*Maní* (peanut)	C	Seed	XX	Fruit in soil
Cajanus bicolor	*Puspu-poroto* (pigeon pea)	C	Seed cooked	X	From low branches
(*Campsiandra* not used locally)					
Canavalia ensiformis	*Nescafé*	C	For coffee	X	From vine
Dialium guianense	*Palo de sangre*	W	Dry sweetish pulp	No	From ground
Dipteryx rosea	*Charapillo, shirahuaco*	W	Seed cooked with salt, also for tamales	No	From ground
Hymenaea oblongifolia	*Azucar huayo*	W	Sweetish pulp	No	From ground
Hymenaea palustris	*Azucar huayo*	W	Sweetish pulp	No	From ground
Inga alba	*Shimbillo*	W	Sweet pulp	X	With pole
Inga aria	*Shimbillo*	W	Sweet pulp	X	With pole
Inga dumosa	*Shimbillo*	W	Sweet pulp	X	With pole
Inga edulis	*Shimbillo*	C	Starchy pod	X	With pole
Inga marginata	*Shimbillo*	W	Sweet pulp	No	With pole

Table 1. Continued.

Species[a]	Vern. name (English name)[b]	Status[c]	Use	Sold in Iquitos[d]	Harvesting method
Inga minutula	*Guavilla*	W/C	Sweet pulp	XX	Hooked pole or climbing
Inga pruriens	*Coto shupa shimbillo*	W	Sweet pulp	No	With pole
Inga spectabilis	*Shimbillo*	C	Sweet pulp	X	With pole
Inga sp. (V10552)	*Rosca shimbillo*	W	Sweet pulp	X	With pole
Phaseolus vulgaris	*Frijol* (bean)	C	Seed	XX	Low vine
Vigna unguiculata	*Caspi chiclayo*	C	Cooked seeds	XX	Low vine
Malpighiaceae					
Bunchosia armeniaca	*Indano*	W	Pulp	X	Low branches
Malpighia punicifolia	*Cerezo*	C	Pulp	No	Low branches
Melastomataceae					
Bellucia grossularioides	*Nispero, sacha nispero*	W	Pulp	X	Hooked pole
Bellucia pentamera	*Nispero, sacha nispero*	W	Pulp	X	Hooked pole
Clidemia hirta	*Mullaca morada*	W	Berry	No	From shrub
Mouriri acutiflora	*Lanza caspi*	W	Pulp	No	Hooked pole or climbing
Mouriri grandiflora	*Lanza caspi*	W	Pulp	No	Hooked pole or climbing
Moraceae					
Artocarpus altilis	*Pan del arbol, pandicho* (breadfruit)	C	Starchy pulp	X	From ground
Artocarpus heterophyllus[f]	*Pandicho* (jackfruit)	C	Seeds	No	From trunk
Brosimum guianensis	*Mishochaqui*	W	Starchy pulp	No	From ground
Brosimum lactescens	*Tamamuri*	W	Refresco	X	From ground
Helicostylis scabra	*Mishochaqui*	W	Fleshy pulp	No	From ground
Helicostylis tomentosa	*Mishochaqui*	W	Fleshy pulp	No	From ground
Naucleopsis concinna	*Llanchama*	W	Fleshy pulp	No	From ground
Naucleopsis mellobarretoi	*Llanchamillo*	W	Fleshy pulp	No	From ground
Pourouma cecropiifolia	*Ubilla, chimiqua*	W/C	Sweet pulp	XX	Hooked pole or from ground
Pourouma minor (2 forms)	*Sacha ubilla*	W	Sweet pulp	No	Hooked pole or from ground
Pourouma minor (form 3)	*Chullachaqui blanca*	W	Sweet pulp	No	Hooked pole or from ground
Pourouma cucura	*Sacha ubilla*	W	Sweet pulp	No	Hooked pole or from ground
Pseudolmedia laevis	*Mishochaqui, chimiqua*	W	Sweet pulp	No	From ground
Musaceae					
Musa acuminata	*Guineo* (banana)	C	Sweet pulp	XX	Raceme or culm cut
Musa paradisiaca	*Plátano*	C	Starchy pulp	XX	Raceme or culm cut
Myristicaceae					
Iryanthera paraensis	*Cumala colorada*	W	Arils cooked	No	Hooked pole
Iryanthera ulei (*Virola surinamensis* not eaten in Iquitos area)	*Cumala colorada*	W	Arils cooked	No	Hooked pole
Myrtaceae					
Eugenia stipitata	*Arasa*	C	Refrescos	X	Pole, from branches
Eugenia sp. (V10116)	*Juanache*	W	Refrescos	No	From shrub
Myrciaria dubia	*Camu camu*	W	Refrescos	XX	Picked from shrub
Myrciaria floribunda	*Camu camu*	W	Refrescos	No	Pole, from branches
Psidium guajava	*Guava*	C/W	Sweet pulp	X	Pole
Syzygium cuminii	*Aceituna*	C	Sweet pulp	No	Hooked pole
Syzygium jambos	*Pomarosa* (rose apple)	C	Sweet pulp	No	Hooked pole
Syzygium malaccense	*Aceituna dulce*	C	Sweet pulp	X	Hooked pole or climbing
Olacaceae					
Minquartia cf. *guianensis* (not *M. guianensis*)	*Huacapú*	W	Sweet pulp (2 cm long)	No	From ground
Oxalidaceae					
Averrhoa bilimbi	*Limon chino*	C	Refrescos	X	By hand or pole
Averrhoa carambola	*Carambola*	C	Refrescos	X	By hand or pole
Palmae					
Astrocaryum chambira	*Chambira*	W	Starchy pulp	XX	Tree cut or pole
Astrocaryum jauari	*Huiririma*	W	Starchy pulp	X	Tree cut
Astrocaryum macrocarpum	*Huicungo*	W	Starchy pulp	X	Pole
Attalea tessmannii? (G29032)	*Shapaja*	W	Raw seed	No	Tree cut

Table 1. Continued.

Species[a]	*Vern. name (English name)*[b]	*Status*[c]	*Use*	*Sold in Iquitos*[d]	*Harvesting method*
Bactris gasipaes	*Pibuayo, pijuayo*	C	Cooked starchy pulp, masato	XX	Climb adjacent tree with pole
Bactris brongniartii	*Ñejilla*	W	Sweet pulp	X	By hand
Bactris concinna	*Ñejilla*	W	Sweet pulp	X	By hand
Bactris maraja	*Ñejilla*	W	Sweet pulp	X	By hand
Elaeis guineensis	*Palma aceitera*	C	Oil from seed	X	Hooked pole
Elaeis oleifera	*Puma yarina, peloponte*	W	Oil from seed, pulp cooked	No	Hooked pole
Euterpe precatoria	*Chonta, huasai*	W	Refresco	No	Tree cut
Euterpe sp. (G31674)	*Chonta*	W	Refresco	No	Tree cut
Jessenia bataua	*Ungurahui*	W	Refresco, oil, ice cream	XX	Tree cut
Mauritia flexuosa	*Aguaje*	W	Refresco, pulp, ice cream	XX	Tree cut
Mauritiella cf. *peruviana* (G28864)	*Aguajillo*	W	Refresco, pulp	X	Tree cut
Maximiliana maripa (V9185)	*Shapajilla*	W/C	Cooked starchy pulp (also seed)	No	From ground
Oenocarpus mapora	*Sinamillo*	W	Refrescos, oil	X	Tree cut
Oenocarpus minor (V5216)	*Sinamillo*	W	Refrescos	No	Tree cut
Orbignya polysticha (V7756)	*Shapaja*	W	Seeds	No	Stemless
Phytelephas macrocarpa	*Yarina*	W	Seeds and "milk"	X	Low tree
Phytelephas microcarpa	*Yarina*	W	Starchy fruits	X	Low tree
Scheelea moorenii	*Catirina, shebón*	W	Raw seeds	X	Stemless
Scheelea plowmanii	*Shapaja*	W	Raw seeds	X	Stemless
Scheelea princeps? (V9185)	*Shapajilla*	W	Pulp	No	From ground
Scheelea salazarii (G38074)	*Shapaja*	W	Raw seeds	No	With pole
Passifloraceae					
Passiflora candolleana	*Granadilla sapo*	W	Pulp	No	By hand
Passiflora edulis	*Maracuyá*	C	Refresco	X	By hand
Passiflora quadrangularis	*Tumbo*	C/W	Refresco	X	By hand
Passiflora nitida	*Granadilla*	W	Refresco	X	By hand
Passiflora vespertilio	*Granadilla*	W	Refresco	X	By hand
Rosaceae					
Prunus avium	*Cerezo* (cherry)	C	Fleshy pulp	No	Low branches
Rubiaceae					
(*Alibertia edulis* not used locally)					
Genipa americana	*Huito*	W/C	Sweet pulp and alcoholic drink	X	From ground
Coffea arabica	*Café*	C	Coffee	X	Shrub
(*Borojoa* not used locally)					
(*Posoqueria latifolia* not used locally)					
Rutaceae					
Citrus sinensis	*Naranjo* (orange)	C	Pulp, jugo	X	Pole
Citrus aurantifolia	*Limón* (lime)	C	Refresco	X	Pole
Citrus reticulata	*Tangerina* (tangerine)	C	Pulp	X	Pole
Citrus medica	*Citrón*	C	Refresco	X	Pole
Citrus limonia	*Limón sutil*	C	Pulp	X	Pole
Citrus paradisi	*Toronja* (grapefruit)	C	Pulp	X	Pole
Sapindaceae					
(*Paullinia cupana* = guarana, not grown locally but bottled drink from Brazil is drunk)					
Talisia cerasina (V6358)	*Virote huayo*	W	Fleshy pulp	No	Tree bent over
Sapotaceae					
Micropholis egensis	*Caimitillo, quinilla*	W	Sweet pulp	No	From ground or bending branches
Micropholis venulosa	*Caimitillo*	W	Sweet pulp	No	From ground or bending branches
Pouteria caimito	*Caimito*	C/W	Sweet pulp	XX	Climb tree
Pouteria macrophylla	*Lucuma*	C	Sweet pulp, ice cream	X	Climb tree
Pouteria sp. (V11877)	*Caimitillo*	W	Sweet pulp	No	Tree cut
Pouteria cuspidata (G42807)	*Caimitillo*	W	Sweet pulp	No	From ground
Pouteria laevigata (Diaz 441)	*Caimitillo*	W	Sweet pulp	No	From ground
Pouteria multiflora (G42641)	*Caimitillo*	W	Sweet pulp	No	From ground
Pouteria plicata (G18349)	*Caimitillo*	W	Sweet pulp	No	From ground

Table 1. Continued.

Species[a]	*Vern. name (English name)*[b]	*Status*[c]	*Use*	*Sold in Iquitos*[d]	*Harvesting method*
Pouteria procera (G29002)	*Caimitillo*	W	Sweet pulp	No	From ground
Pouteria spp. (ca. 7)	*Caimitillo*	W	Sweet pulp	No	From ground
Solanaceae					
Capsicum frutescens	*Ají* (hot pepper)	C	Condiment	XX	Shrub
Cyphomandra hartwegii	*Tomate de arbol, gallinazo panga*	W	Refresco	No	Hand or pole
Lycopersicon esculentum	*Tomate*	C	Pulp	XX	Herb
Physalis angulata	*Bolsa mullaca* (ground cherry)	W	Pulp	X	Herb
Solanum jamaicense	*Coconilla con espinas*	W	Pulp	No	Shrub
Solanum stramonifolium	*Coconilla*	W	Refresco	X	Shrub
Solanum sessiliflorum	*Cocona*	C	Refresco	X	Shrub
Sterculiaceae					
Herrania nitida	*Cacahuillo, flor de araña*	W	Pulp	No	Cauliflorous
Theobroma bicolor	*Macambo*	C	Refresco, insipid pulp, cooked seeds	X	Hooked pole
Theobroma cacao	*Cacao*	W/C	Chocolate, pulp	X	Hooked pole
Theobroma obovata	*Cacahuillo*	W	Pulp, seed	X	Hooked pole
Theobroma grandiflorum	*Copuassú*	C	Refresco, pulp	X	Hooked pole
Theobroma subincanum	*Cacahuillo*	W	Pulp	No	Hooked pole, tree cut
Verbenaceae					
Lantana trifolia	*Tunchi albaca*	W	Small berry	No	By hand

[a] *Vouchers cited only for taxonomic problems; V = Vasquez collection number; G = Gentry collection number.*
[b] *English names in parentheses when different from Spanish.*
[c] *W = wild; C = cultivated; W/C = both wild and cultivated.*
[d] *X = observed sold in Mercado Belén, Iquitos; XX = very important fruit in Mercado Belén.*
[e] *Formerly sold in market but not observed in recent years.*
[f] *Only cultivated downriver near Leticia.*

were reported by van den Berg (1984) as being sold in the Ver-o-peso market at Belem, Brazil.

There are interesting similarities and differences between the fruit species eaten at Iquitos and those eaten in Amazonian Brazil. The fruits of 37 families are listed by Cavalcante (1972, 1974, 1979) as consumed in Amazonian Brazil, although five of these families are different from the 39 whose fruits are consumed in the Iquitos area. Cavalcante reports that 167 species of fruits are consumed in Amazonian Brazil, nearly the same number of edible species we report here for the Iquitos area. Cavalcante's breakdown between wild-harvested (121, including 19 also cultivated) and exclusively cultivated (45) species is also nearly identical to the Iquitos area data. Moreover, Cavalcante lists the same families as at Iquitos — i.e., Palmae, Leguminosae, Myrtaceae, and Sapotaceae — as having the most edible fruit species. However, there is surprisingly little overlap between the actual species of wild-harvested fruits of Amazonian Brazil and those of the Iquitos area. Only one-fourth (32 of 121) of the wild-harvested fruit species listed by Cavalcante for Brazil are also wild-harvested at Iquitos, although 80 percent of his cultivated fruit species are also consumed at Iquitos. These differences are not due entirely to phytogeographical differences, since at least 15 of the wild-harvested species listed by Cavalcante occur near Iquitos but to our knowledge are not eaten. Similarly, of the 15 presumably wild-harvested species listed by van den Berg (1984) as among the 43 most-appreciated fruit species at Belem, only 5 are eaten around Iquitos (one of these, the Brazil nut, exclusively from cultivated trees), while the cultivated fruits of the Iquitos area are nearly the same as those cultivated at Belem, with only four of the Belem-cultivated fruit species — mamey, coconut, sapote, and tamarindo — absent from the Iquitos market. We may safely conclude, then, not only that many species of wild fruits are eaten in the Iquitos area, but that many of these are different from those consumed elsewhere, even in nearby parts of Amazonia.

Some of the wild-harvested fruit species listed in Table 1 are eaten only occasionally. Others are harvested only for consumption by a campesino and his immediate family, without, to our knowledge, ever being offered for sale. However, of the 167 fruit species included in Table 1, 52 wild-harvested species are sold in the Iquitos market, at least occasionally. Table 2 records the fruits we observed to be sold fairly regularly in the market, along with their stated prices. These may be regarded as species that have reached a stage of incipient

Table 2. Prices for some common wild-harvested fruits in Iquitos market, Feb. 1987.

Spondias mombin	½ kg for 10 intis 5 intis/bag (ca. 40 frt.)
Spondias dulcis	2 intis/frt.
Couma macrocarpa	1 inti/frt.
Lacmellea peruviana	10 frts./inti
Quararibea cordata	5 intis/frt.
Rheedia benthamiana	3 intis/bag (24 frt.)
Rheedia gardneriana	5 intis/bag (27 frt.)
Grias neuberthii	10 intis/frt. (ca. 300 gm)
Gustavia longifolia	3 intis/frt.
Inga dumosa	2 frts./inti
Inga edulis	5 intis/frt.
Inga spectabilis	5 intis/frt.
Inga minutula	2 frts./inti
Pourouma cecropiifolia	20 intis/maceta (= ca. 2 inflor.)
Myrciaria dubia	5 intis/bag (ca. 25 frts.) (80–100 intis/20 kilo box)
Astrocaryum chambira	5–10 intis/plate (ca. 9 frts./inti) (peeled = 1 sol each additional)
Astrocaryum jauari	20 frts./inti
Astrocaryum macrocarpum	5 intis/plate (ca. 15 frts.)
Jessenia bataua	½ kg/5 intis; 50 kg./200 intis
Mauritia flexuosa	3 frts./10 intis; 450 intis/50 kg
Orbignya polysticha	2 intis/inflor. (4–5 frts.)
Phytelephas microcarpa	1 inti/frt.
Genipa americana	3 intis/frt.
Theobroma bicolor	15–20 intis/frt.
Theobroma cacao	5–10 intis/frt. (only sell wild-harvested frts.)
Physalis angulata	1 inti/bag (ca. 40 frts.)
Solanum stramonifolium	ca. 15 frts./inti
Solanum sessiliflorum	5 intis/bag (ca. ½ kg.)

commercialization. Altogether, over half the fruit species sold in the Iquitos market are wild-harvested. If fruits used as vegetables (i.e., cucumbers, tomatoes, etc.) or starchy staples (plantains, beans) are excluded, we estimate that about half of the fruit vendors in the Iquitos market (13 of 28 fruit venders in the first block of the Mercado Belén on 20 July 1987) sell wild-harvested fruits. Wild-harvested fruits are clearly an important product in Amazonian Peru, even in the urban market of Iquitos.

We have also made anecdotal observations of apparent changes in patterns of fruit consumption in Iquitos. We believe that the sale of wild-harvested fruits in the Iquitos market has increased significantly over the last 10 years. This is due in part to their appreciation by former campesinos, accustomed to eating a wide variety of native fruits, who have recently immigrated to the city, and in part to their relatively low cost compared to fruits such as apples and oranges, which are imported to Iquitos from faraway parts of Peru.

Curiously, the wild-harvested fruits sold on the market are not necessarily the same species we have observed to be preferred in the *campo.* Especially conspicuous are the absence of fruits much esteemed by forest-dwelling campesinos, such as *naranjo podrido* (*Parahancornia*) and *charapilla* (*Dipteryx*), and the near-absence of *inchi* (*Caryodendron*) from the market. Perhaps some fruit species are so desirable that they are eaten on the spot? Or perhaps the esteemed but not commercialized species are produced in too small a quantity or are too subject to spoilage to be transported to the urban market? These might be just the fruit species most appropriate for development as new crops under the concept of a "forest-industrial complex" advanced by Myers (1984). Clearly, increasing the number of crop species utilized will broaden the agricultural base and help provide insurance against disaster resulting from plagues, market vagaries, or drought (e.g., Balick & Gershoff 1981). Moreover, many of the little-known fruit species are adapted to marginal environments where few traditional crops flourish.

Already native fruit trees such as the palms *Jessenia, Oenocarpus,* and *Mauritia* are being widely touted (e.g., Balick 1981; Anonymous 1985) as potential new tree crops (Balick & Gershoff 1981; Balick 1982), and efforts are being made to establish experimental plantations of such species (e.g., Balick 1979; Clement & Mora Urpi 1987). Although there will obviously be a long lag between experimental plantations and crop production, more immediate production could be achieved from existing wild-growing native trees. The progression from forest tree to cultivated crop can be regarded as having five steps: (1) occasional in situ consumption, (2) carrying home of wild-harvested fruits for local consumption, (3) sale of wild-harvested fruits on the urban market, (4) use of the species as a dooryard crop, and (5) use of the species as a plantation crop (e.g., Caballero 1987). The first three of these steps, the ones pertinent to this paper, all belong to what Bates (1985) calls the tertiary pool of exclusively wild-harvested crops, the uses of many of which have not yet been reported (Toledo 1987).

Several of the more popular Iquitos-area fruit species have reached the transition stage from wild-harvested to dooryard crop (Padoch et al. 1985; Hiraoka 1986), or the secondary pool of Bates (1985). Padoch et al. (1985: 50) estimate that 63 percent of the annual income of campesino families at Tamshiyacu, near Iquitos, is derived from fruits from agroforestry, mostly *umari* (*Pouraqueiba sericea*), but also palms, avocados (*Persea americana*), Brazil nuts (*Bertholletia excelsa*), and citrus. According to Hiraoka (1986), these dooryard plantations are a product of the last 35 years, prior to which the local populace met cash needs by exploiting forest products and cultivating barbasco for fish poison.

The highly esteemed fruit species that are beginning to be occasionally cultivated would seem to be precisely those whose production should increase as de-

mand and markets grow, potentially giving rise to new export crops and new industries. Indeed, this has already happened with the *aguaje* palm (*Mauritia*), which produces one of the best local ice cream flavors in Iquitos; in 1975, export of a limited quantity of *aguaje* pulp to Japan as a novelty ice cream flavor was begun. Biologists pointed with pride to this promising development as proof that new forest products have export value.

Even on the local market the cash value of wild-harvested fruits can be significant. Peters (1988; Peters et al. 1989) has begun to document the commercial use of this kind of resource. For example, Peters (personal communication) estimates that the *camu camu* harvested from wild populations in the Jenaro Herrera area yearly amounts to $167 per ha or a total cash value of $10,000 per year for a 60 ha study area. Moreover, we (Peters et al. 1989; see also Gentry 1986) have shown that the value of fruits produced by a typical ha of Amazonian forest near Iquitos is $650 per year; indeed fruit and latex represent over 90 percent of the total market value of the forest, a present net value of $6,330 per ha as compared to a present net value of $490 per ha for timber.

In Tables 1 and 2 we document the use of a wide variety of wild fruits in the Iquitos area. Padoch (1988) has also emphasized the substantial economic benefits that arise from the sale of one of these fruits, the *aguaje* palm, the commercialization of which she estimates to support 500 Iquitos families, at least partially. We estimate that at least one-tenth of the diet of many Iquitos-area campesinos comes from wild-harvested fruits. Although this figure is admittedly subjective and highly subject to seasonal fluctuation (Padoch 1987, 1988), it is abundantly clear that wild-harvested fruits play a major economic role in the Iquitos area. In the extreme case, we have observed that some campesinos and forest laborers such as woodcutters may subsist almost entirely on wild-harvested fruits such as *ungurahui* (*Jessenia*), *charapilla* (*Dipteryx*), or *metahuayo* (*Caryodendron*) for a day or more at a time. Even in the city of Iquitos the diet of the poorer people includes a substantial complement of wild fruits, although more affluent people tend to use less fruit, and most of it is from cultivated species.

In summary, it seems clear that, even in their natural state, tropical forests of Amazonian Peru are capable of producing a significant and sustainable yield of many kinds of wild fruits. Moreover, some of these native tree species show definite potential for more intensive, even plantation-style, agronomic development that could lead to important new tree crops (Padoch et al. 1985; Hiraoka 1986; Myers 1986). The diversity of these forests (Gentry 1986, 1988) is often considered an economic disadvantage, but this plethora of species could be converted into an economic advantage by utilizing their fruits. To the producer, one of the most obvious advantages of high diversity is the far broader agricultural base than exists in traditional agriculture; to consumers, perhaps the greatest benefit is the enrichment of access to many new and delightful tastes. To the pragmatic conservationist, increased appreciation of the value of tropical forests and their products is a key component to developing sound management strategies based on sustainable use rather than exploitation.

Misuse of Incipient Crop Species

While much recent conservation interest has focused on the positive aspects of a local Amazonian economy based on forest products and agroforestry (e.g., Padoch et al. 1985; Hiraoka 1986; Myers 1984, 1986), the potential negative aspects of such an economy have been largely overlooked. There is an underlying assumption among conservationists that if we can only get rid of the temperate-style agronomist's obsession with mechanized large-scale farming of monocultures, we can learn from aboriginal groups or other forest dwellers who live in harmony with the forest to use it as a sustainable resource (e.g., Posey 1984; Prance et al. 1987). Implicit in this conservation strategy is the assumption that, given the demands of modern society and today's population pressures, a mechanism can be found to expand indigenous technologies and products to support a broader consumer base. In the following section of this paper we present evidence that this assumption may be overly optimistic in the case of wild-harvested fruits. If developing new markets for tropical forest fruits is to be an effective conservation strategy, the new products must be discovered and markets for them must be developed. The most critical step for conservation, however, may be an intermediate one that has received relatively little attention — preventing the destruction of the trees themselves during the harvesting process.

Perhaps the most promising of the wild-harvested fruit species is the *aguaje* palm (Fig. 1), which grows in extensive pure stands called *aguajales* in permanently swampy areas where conventional agriculture would be impossible (ONERN 1976; Padoch 1988). Curiously, production, instead of increasing with increasing value, seems to be decreasing. In February 1987, not one *aguaje* fruit was to be found in the Iquitos market, although there were still a few being sold by sidewalk vendors (at the inflated price of 3.3 *intis/aguaje*). *Chupetes de aguaje,* formerly the favorite local ice cream bar sold by dozens of sidewalk vendors, were no longer available either. Although some of this scarcity is due to seasonality of production, even at the peak of the 1987 *aguaje* season from July to September there appeared to be fewer *aguaje* fruits than in the past, and the price remained relatively high (never less than 0.6 *intis/aguaje*). In 1988 the cycle seems to be repeating itself.



Figure 1. Mauritia flexuosa (aguaje), *a disappearing resource. A. Nondestructive harvesting of* aguaje *via bamboo "ladder." Arrow indicates boy harvesting infructescence. B. Bowl of* aguaje *fruits for sale in Iquitos market.*

The same phenomenon has taken place with *ungurahui* (*Jessenia*), which as of February 1987 was on sale by a single vendor in the Iquitos market. *Naranjo podrido,* considered by some to be among the most delectable fruits of the Iquitos region, has been virtually absent from the market for several years although it used to be sold frequently (J. Torres, personal communication). Most of the wild-harvested fruits with the clearest potential as major crops (Table 3) seem to be decreasing in availability.

In the case of *aguaje,* fruit harvesting by cutting down the trees is clearly responsible for the current scarcity of the nascent resource. Very few harvesters of *aguaje* fruits climb the tree; instead they cut a tree down to obtain the fruits, even when the fruits are low enough to reach with a ladder. Years of such destructive harvesting have decimated the *aguaje* populations near human population centers. *Mauritia* is dioecious, and near Iquitos, the once extensive *aguajales* or *Mauritia* swamps have been converted to pure stands of useless male trees. Female *Mauritia* trees are essentially extinct locally except for occasional cultivated trees. This wholesale destruction is now apparent even in relatively isolated *caserias.* For example, at San José de Parinari on the Río Marañón, *aguaje* harvesting has been a major local industry. However, instead of having nearby fruits to harvest as they did a few years ago, the harvesters now have to spend 3–4 days walking to reach *Mauritia* with fruits. As a result of destructive harvesting, the harvest of *aguaje* is dwindling. Similar situations at other *caserias* have led to the current acute scarcity of *aguaje* in Iquitos. Indeed, Padoch (1988) reports that *aguajales* as far away as the Napo and Chambira rivers are now being harvested due to exhaustion of the *aguajales* nearer to Iquitos.

Some gatherers now go even farther afield. *Aguaje* also grows in Ecuador, where it is rarely consumed. Recently Ecuadorian forestry officials were amazed to discover a large dugout canoe completely full of *Mauritia* fruits in Ecuador, bound for the Iquitos market about 800 km away (R. Peck, personal communication).

The cost of *Mauritia* fruits in Iquitos has climbed from an average of about 10 *aguaje* fruits/1000 soles five years ago to 3 *aguaje* fruits/10,000 soles (= 10 intis) today. This price increase is far greater than the 527 percent general inflation rate (G. Mayer, personal communication) over the same time period. Adjusted for inflation, there has been approximately a sixfold increase in the price of an *aguaje* fruit over five years! *Aguaje* ice cream bars have all but disappeared; the *chupetes de aguaje* now available are mostly diluted with flour and pumpkin pulp. Several of the local businesses that formerly made ice cream *chupetes* have shut down since their main raw material is now much more expensive and only seasonally available. The promising export of *aguaje* pulp to Japan has ceased.

The same process has taken place with *ungurahui* palms (*Jessenia bataua*), which are now much less common near population centers than formerly. In isolated areas this is a dominant species on certain soil types; for example, in an inventoried ha of forest near Mishana on the Rio Nanay there were 38 trees of

Table 3. Most frequently consumed wild-harvested fruits of the Iquitos area (in approximate order of importance).

		Fruits Available											
No.	Name	J	F	M	A	M	J	J	A	S	O	N	D
1	*Mauritia flexuosa*			√	√	√	√	√	√	√	√	√	
2	*Jessenia bataua*	√	√	√	√	√	√	√	√	√	√	√	√
3	*Myrciaria dubia*	√	√	√	√							√	√
4	*Spondias mombin*	√	√	√	√	√							
5	*Astrocaryum chambira*	√	√	√	√	√							√
6	*Grias neuberthii*	√	√	√	√	√	√					√	√
7	*Rheedia spp.*	√	√	√	√	√							√
8	*Phytelephas macrocarpa*			√	√	√	√						
9	*Physalis angulata*							√	√	√			
10	*Bactris spp.*	√	√	√									√
11	*Couepia spp.*								√	√	√	√	
12	*Couma macrocarpa*		√	√	√								
13	*Parahancornia peruviana*	√	√	√									√
14	*Rhigospira quadrangularis*						√	√	√	√	√	√	
15	*Gnetum spp.*	√	√	√					√	√	√		

Jessenia (several more had been cut down), making this the commonest tree species (Gentry 1986). Stands of forest with abundant *Jessenia*, sometimes called *ungarahuales*, have now disappeared from the Iquitos area except for a few small semicultivated stands.

The situation is even worse for *naranjo podrido* (*Parahancornia*). Once common, *naranjo podrido* has become very rare in settled areas of Peruvian Amazonia. Within a 50 km radius of Iquitos, it is now probably extinct. The cutting of *naranjo podrido* trees is especially tragic since the fruits do not mature synchronously; a tree that can bear 100 or more fruits is sacrificed to obtain perhaps 10 mature fruits and 10 that can be stored to await ripening, while the great majority of immature fruits are simply discarded. Not surprisingly this delicious fruit essentially disappeared from the Iquitos market about 15 years ago (J. Torres, personal communication), although very rarely a few fruits still reach the market (C. Padoch, personal communication). Similarly, populations of *yahuarhuayo colorado* (*Rhigospira*) and *leche caspi* (*Couma*) have been much reduced from former levels, although the latter, part of whose disappearance was caused by cutting thousands of individuals for latex for chewing gum, is sometimes cultivated or semicultivated in the Iquitos area.

Destructive fruit harvesting technology seems generally to be the reason that these potentially commercial fruits are becoming less available. When a large enough demand is generated for a particular fruit, harvesting practices change. Instead of climbing a tree or using a hooked pole to cut down the fruits or infrutescence as they do with occasionally consumed species or with cultivated trees, the local campesinos begin to cut down the trees to obtain fruits for marketing. Thus, the harvest of these highly esteemed but relatively underutilized species is quite different from that used for other fruits eaten in Loreto.

This would seem to be a classic case of the "Tragedy of the Commons" (Hardin 1968). While our observations are mostly anecdotal, the trend seems clear. The recent increases in demand for *aguaje* and *ungarahui* have led to wholesale felling of the wild-growing trees near major population centers and loss of potential new forest resources even as conservation efforts begin to focus on development of rational plans for sustained yield of these same forest products.

We feel that these observations of fruit collecting practices by campesinos in the Iquitos area have important socioeconomic implications. On the one hand there is a wealth of potentially utilizable wild-growing fruit trees in a tropical forest whose commercial development could enrich the lives of fruit-lovers throughout the world. On the other hand, efforts to develop these forest-harvested fruits as part of a balanced conservation and economic strategy for Amazonia must attempt to modify the critical behavioral bottleneck in the process of conversion of potential new crops from local consumption to commercial exploitation. As so often seems to be the case, the most severe problems for tropical forest management and long-term utilization are not biological but social and political.

Relatively ineffective steps to control the exploitation of the two most important fruit species, *Mauritia* and *Jessenia*, have already been taken. The Iquitos Distrito Forestal imposes a tax of .0.2 *intis* per kg for extraction rights and .0.02 per kg destined for use in reforestation. However, to our knowledge these taxes are rarely paid, and nothing has been done to attempt to reforest already decimated areas or to educate the population about the importance of sustainable harvesting techniques. Nothing whatsoever has been done to regulate the harvesting of any of the other fruit species.

Wild-harvested fruits have the potential to be a major sustained-yield resource from tropical forests, one whose exploitation could provide economic incentives for tropical forest conservation. However, this potential

may be lost in the Iquitos area if current trends continue. We hope that our documentation of the wild-fruit resource base in Amazonian Peru and what is happening to it will provide impetus for developing more rational harvesting techniques, and especially for beginning to incorporate a much-needed conservation ethic into the local educational and economic systems.

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